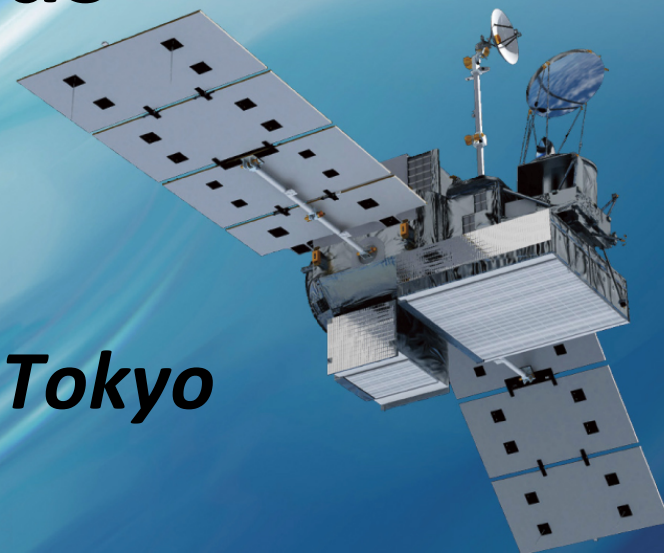


JAXA GPM Science Status

Yukari N. Takayabu , *the Univ. Tokyo*
JAXA GPM Project Scientist



Oct.08,2018 Phoenix

JAXA Science team : 41 PIs for 2018



- * Algorithm developments
- * Validation studies
- * Application studies

→ High Lights

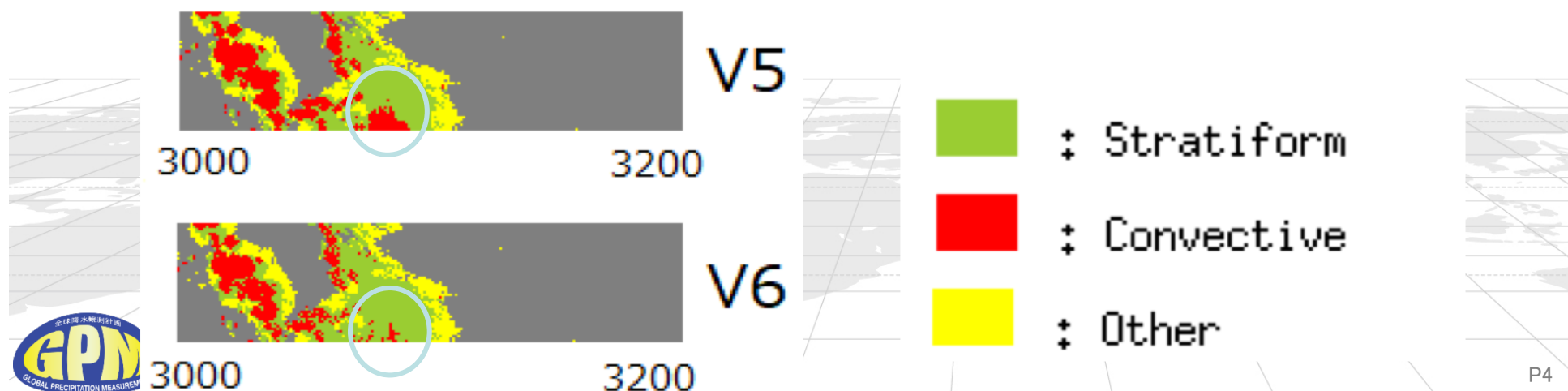


ALGORITHM DEVELOPMENTS

-- DPR, SLH, GSMAP --

NEW RELEASE of DPR and SLH

- * GPM V06 of DPR and SLH started reprocessing, Oct. 4.
 - Details : next presentation by Toshio Iguchi.
- * New main features of the V6 CSF module by J. Awaka
 - * Reclassification of precipitation type
 - * Bug fix on HIP (Heavy Ice Precipitation)
- * Resulting change in SLH (latent heating) product
 - Bottom-heavy bias in SLH V05 is mitigated.



GPM Latent Heating: SLH V06:

Zonal mean Q1-QR AMJ 2014

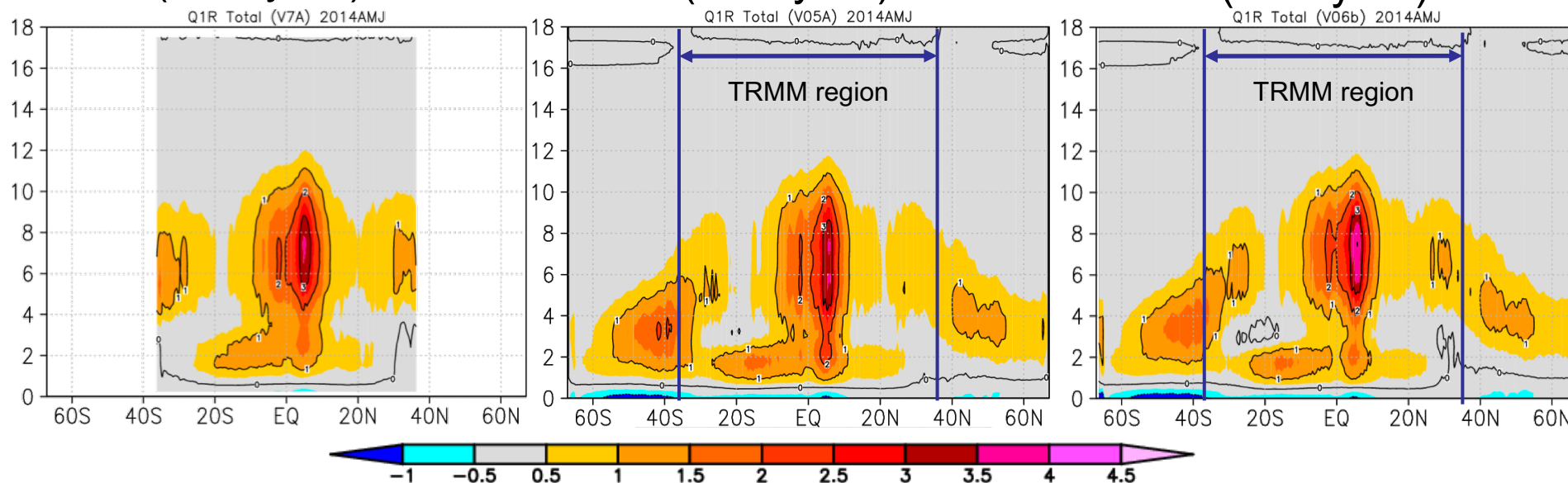
Y. Takayabu



TRMM SLH V7
(19 layers)

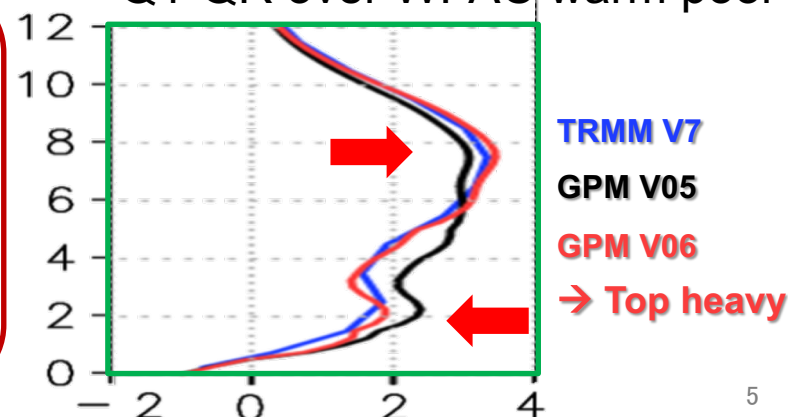
GPM SLH V05
(80 layers)

New Product
GPM SLH V06
(80 layers)



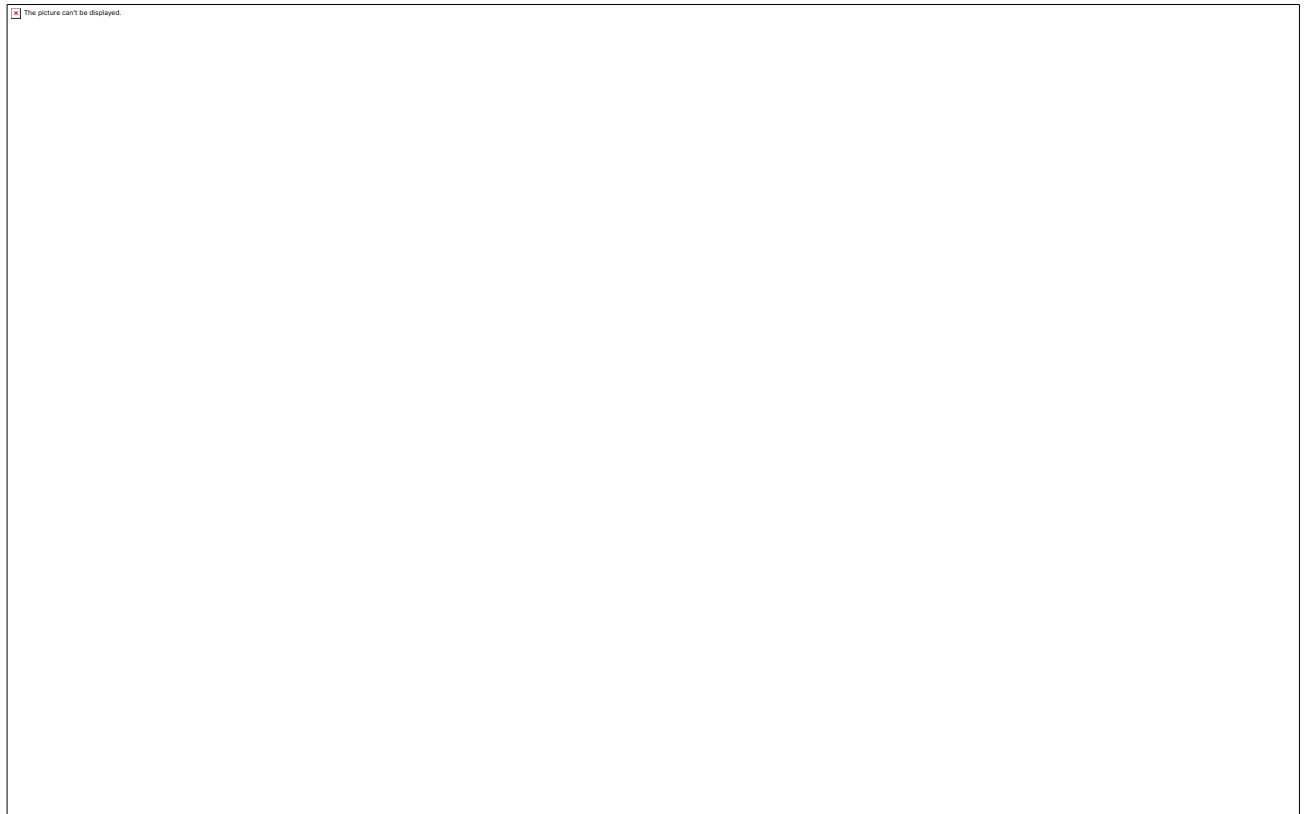
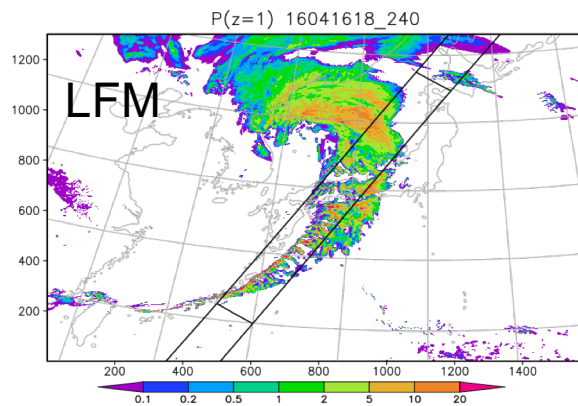
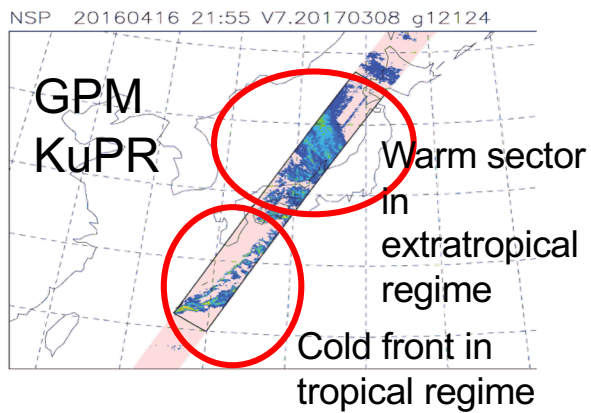
A bottom-heavy bias has been reported with GPM SLH V05. SLH V06 was produced with a new KuPR V06,. The tropical deep profiles became top heavier, which is closer to V7. Mid-latitude heating profiles are smoothly connected to the tropical profiles.

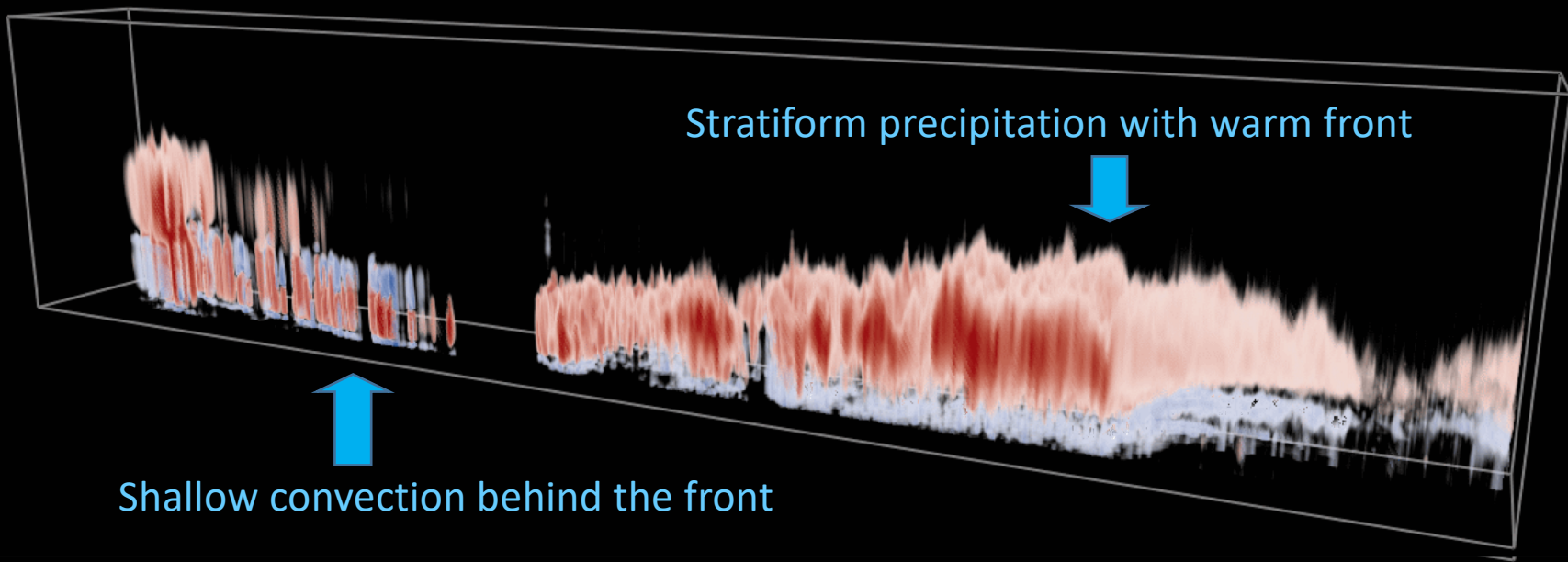
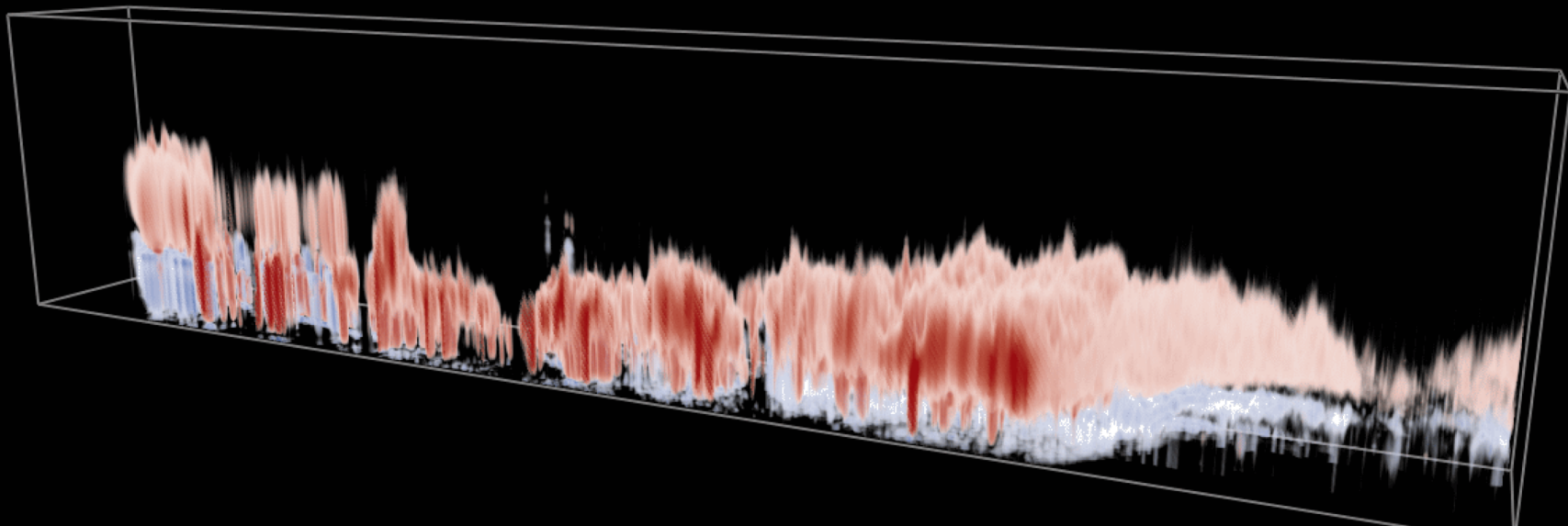
Q1-QR over WPAC warm pool



GPM-Retrieved SLH Latent Heating :

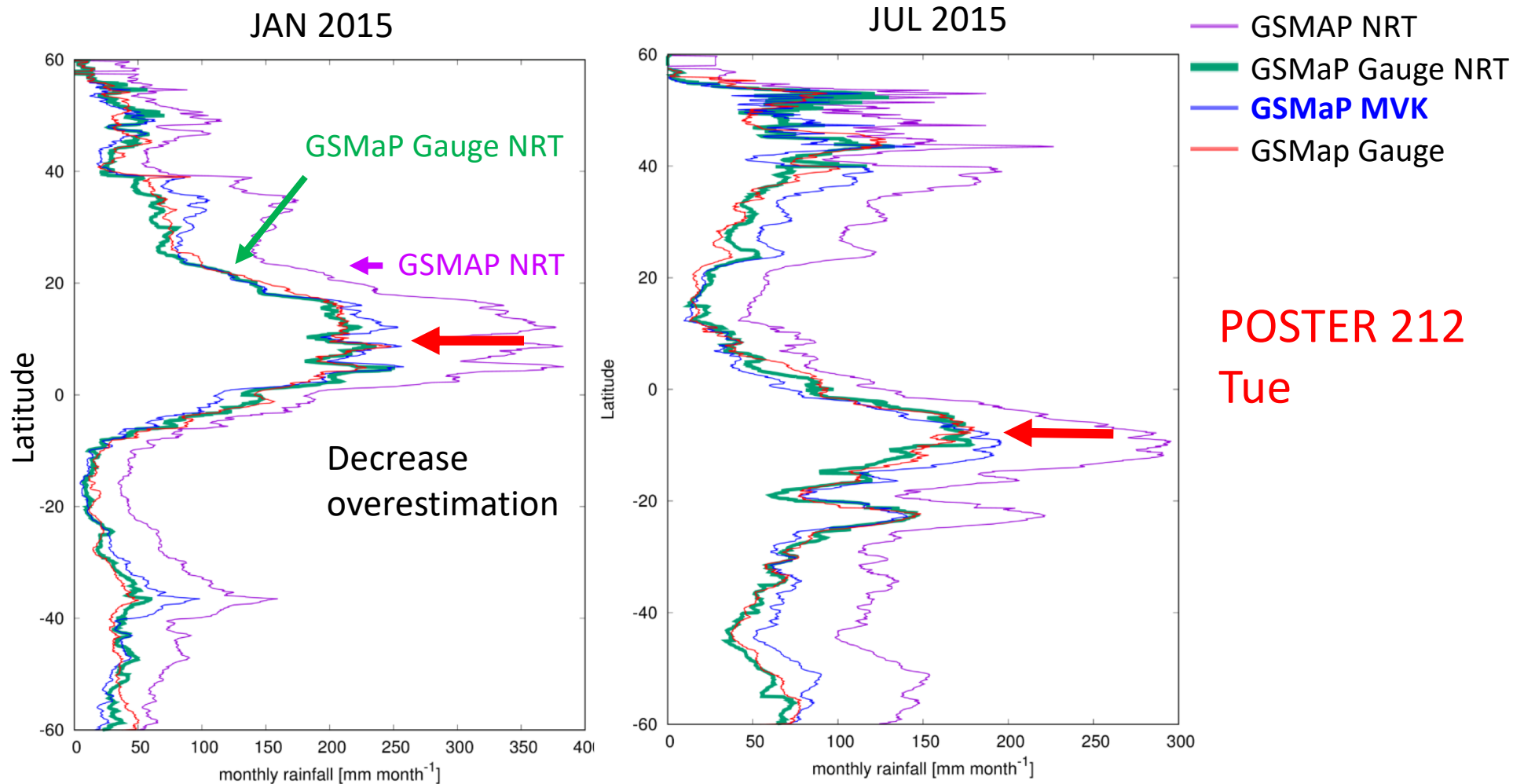
16Apr2016 An Extratropical Cyclone





GSMaP NRT Gauge Zonal Mean

By T. Ushio



- GSMaP NRT had a large bias, GSMaP Gauge NRT mitigated the large bias by obtaining model parameters from recent precipitation data of GSMaP MVK and GSMaP Gauge.

DEVELOPING THE NEXT-GENERATION GSMAP OVER-LAND ALGORITHM: COMPARISON BETWEEN GMI SCATTERING BIAS AND KUPR PRECIPITATION CHARACTERISTICS BY K. AONASHI

Poster 217

Over land, GSMaP scattering bias had high correlation (> 0.54) with Frozen Precipitation Depth (FPD).

GMI scattering retrieval- KuPR surf.precip

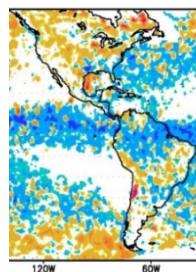
In order to reduce the bias, a new scattering algorithm which considers FPD variations has been developed.

To this end, a statistical fitting of the FPD, with JRA55 lapse rates and RHs using the SVD method (FPD_Env)

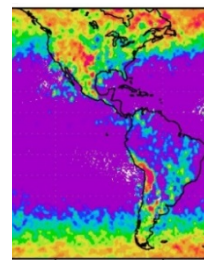
Scattering bias vs. FPD for March – May 2015

(Left) GSMaP scattering bias (mm/day)

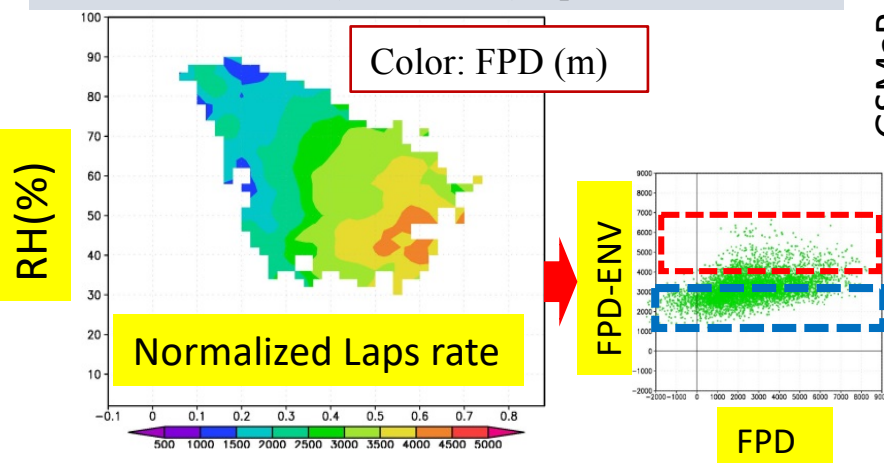
(Right) FPD (m) (KuPR precip top – 0C level)



Good
correspondence
over land

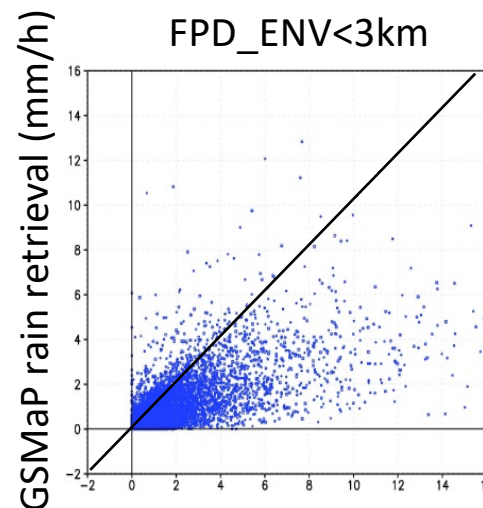


FPD vs low level (1.5–4.5 km) lapse rate and RH

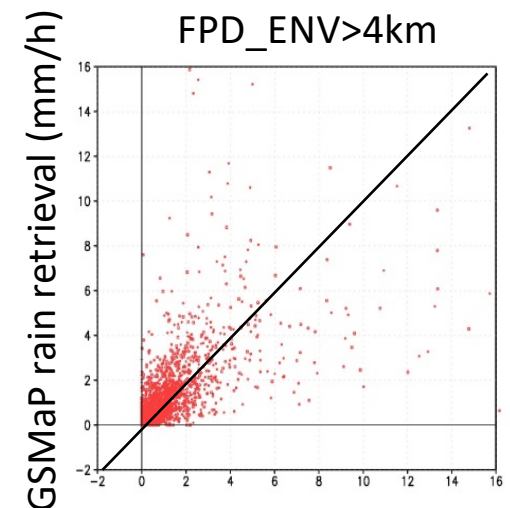


Scatter btw GMI scattering retrieval and KuPR precip

(Land Ts $> 20^{\circ}\text{C}$) (LF) FPD_ENV $< 3\text{ km}$ (RT) FPD_ENV $> 4\text{ km}$



KuPR rainsurf (mm/h)



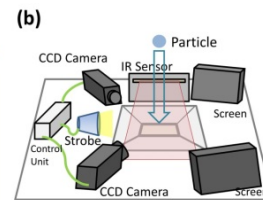
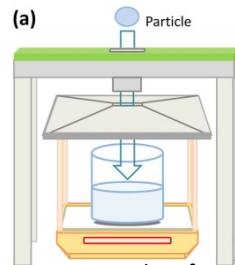
KuPR rainsurf (mm/h)

Good Correlations are found for
deep FPD precipitation

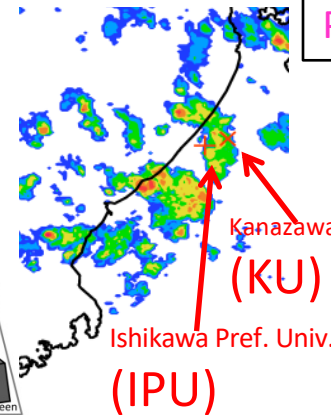
VALIDATION STUDIES

Ground validation of winter snow cloud type classification by G-PIMMS –GPM/DPR match-up case on February 4, 2018

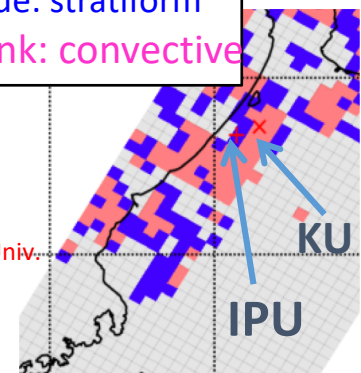
By Kenji Suzuki



JMA radar of snow clouds on 0630JST, Feb.4, 2018

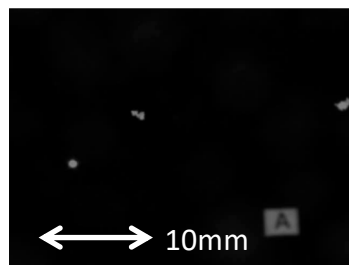


Blue: stratiform
Pink: convective



GPM/DPR Rain type
Stratiform at IPU,
convective at KU

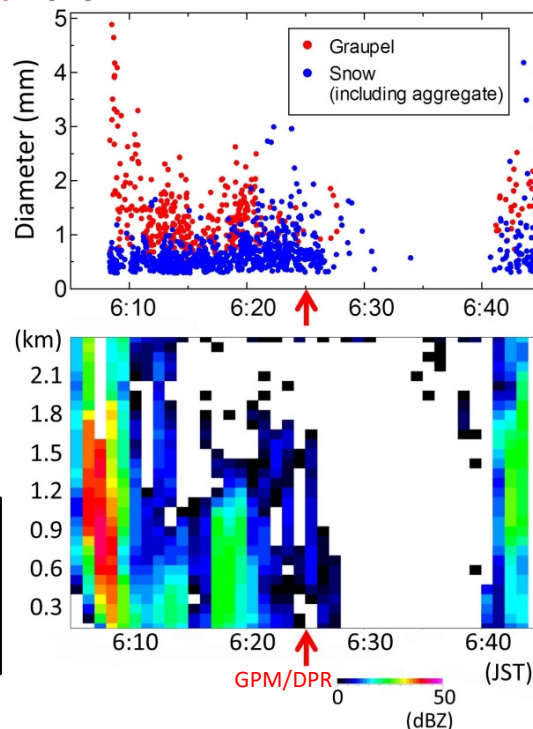
G-PIMMS (a) IPU



G-PIMMS@IPU particle images from 6:20 to 6:30 JST

MRR

G-PIMMS@IPU
Snowflake dominant (Weak snow)
→ **Stratiform?**

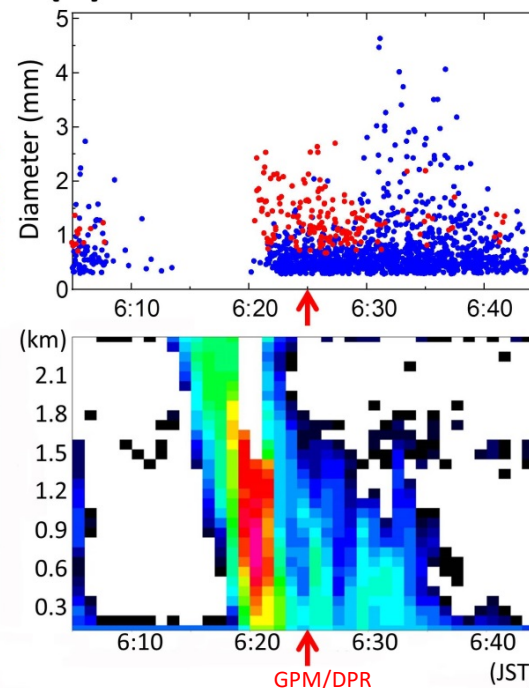


(b) KU



G-PIMMS@KU particle images from 6:20 to 6:30 JST

G-PIMMS@KU
Graupel dominant
→ **Convective?**

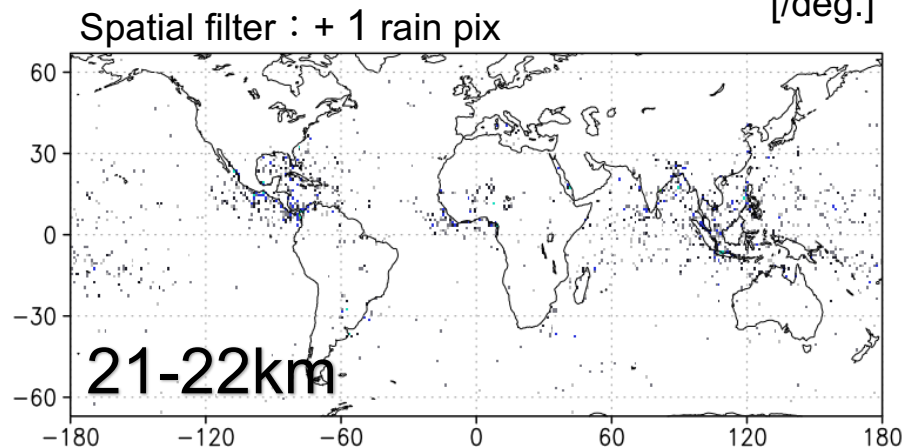
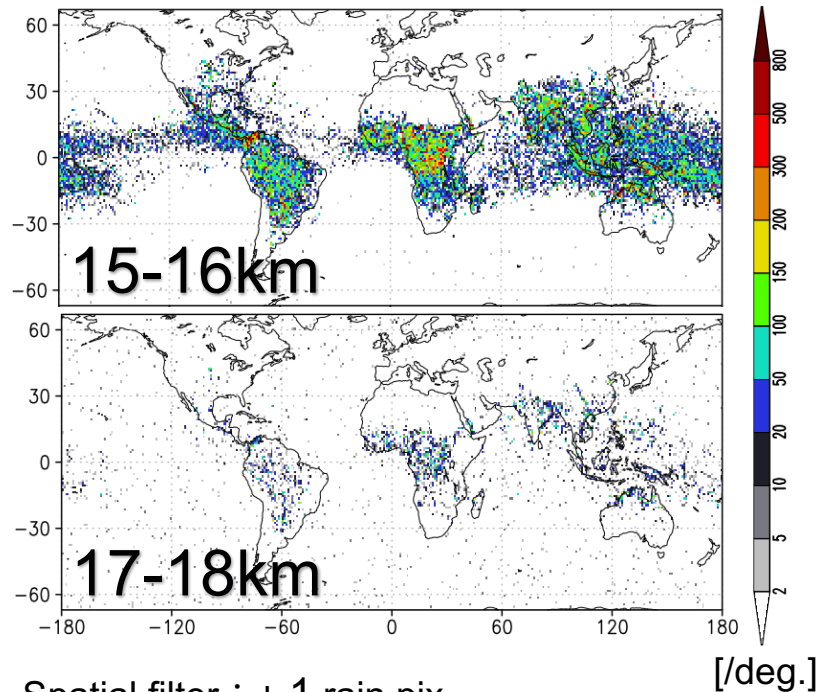


Cause of precipitation echoes above 20 km

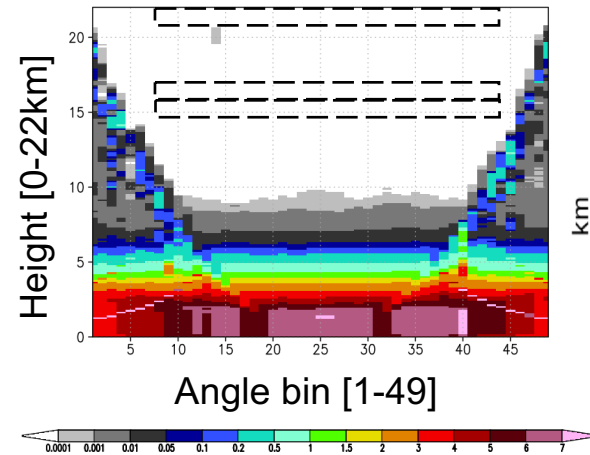
By M. Hirose

Data: 4yr KuNS 05A, 8-42 bins out of 1-49 bins, to avoid the effects of side-lobe clutters

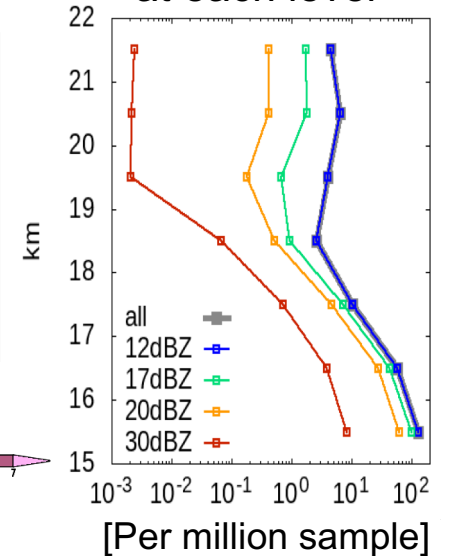
Num of precip samples > 12dBZ



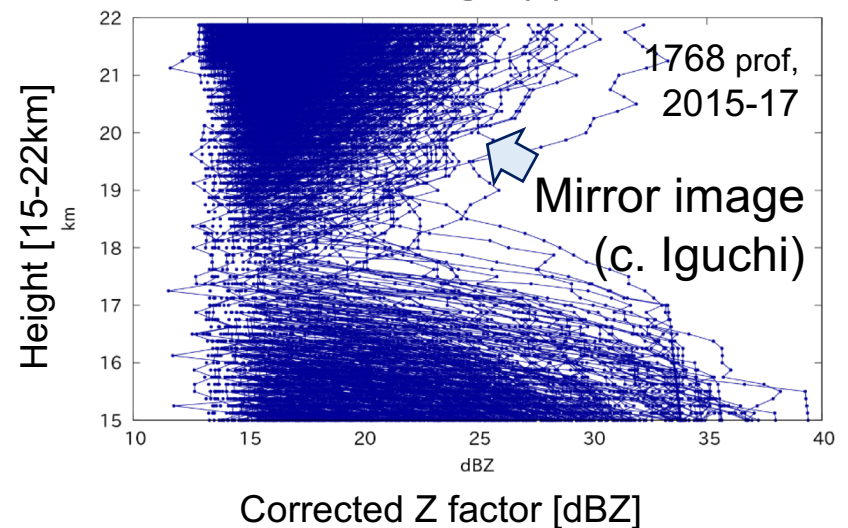
Precip Freq
Ocean, 60-67N



Precip Freq
at each level



Profiles reaching upper obs limit

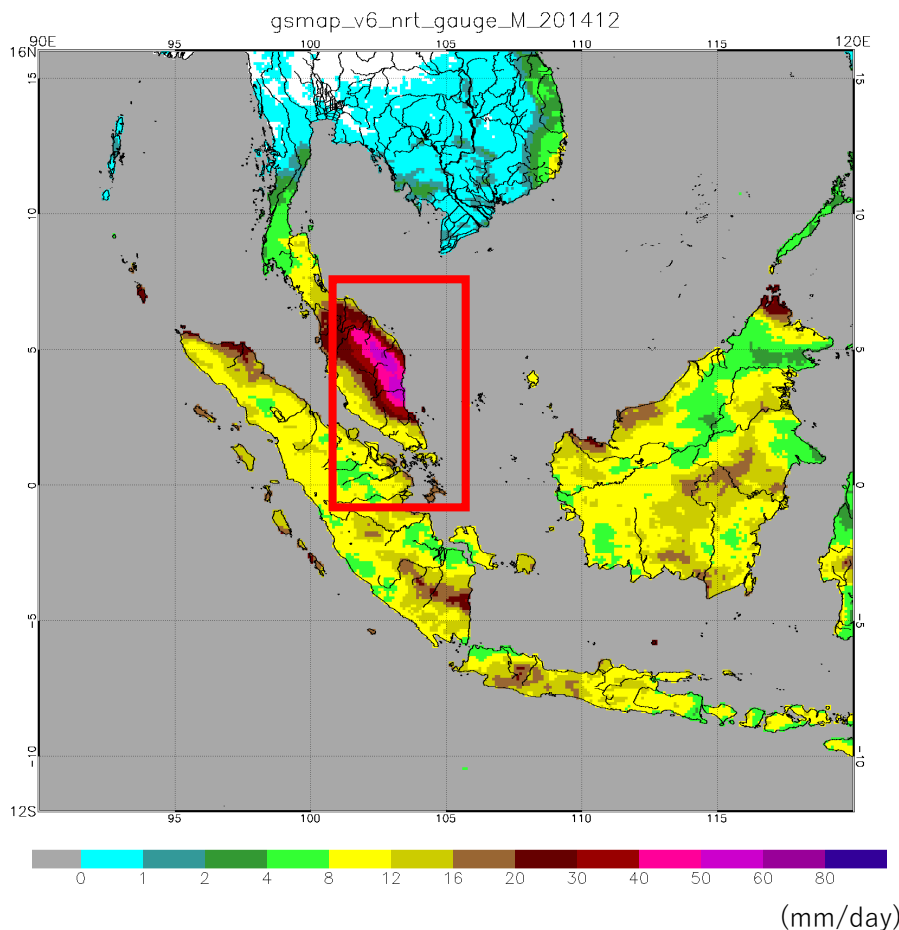


GSMaP: Detection of Monthly Extreme Precip.

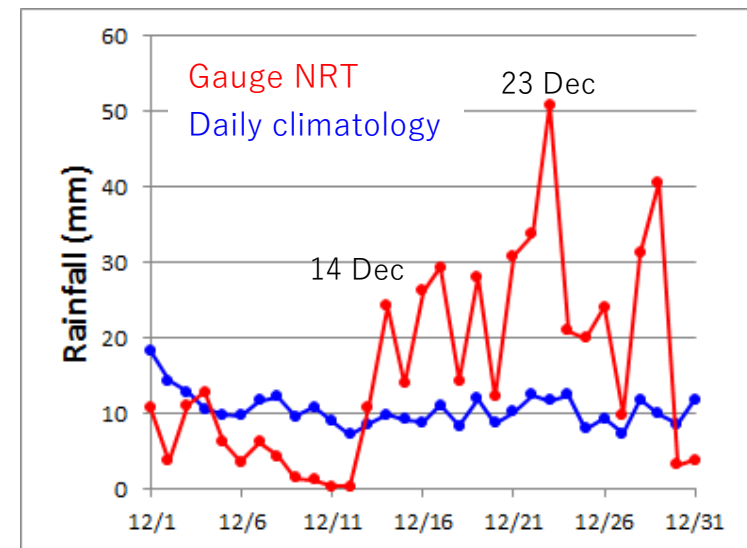
● Dec 2014

Over 95th percentile extreme precipitations are detected in Southern Thai, Malaysia, and Ache Region in Indonesia

(left) Monthly Precip GSMaP Gauge NRT (right) Detected Anomalous Precip



➤ Daily Precip [UTC]
Area Mean (0N-8N, 100E-105E)

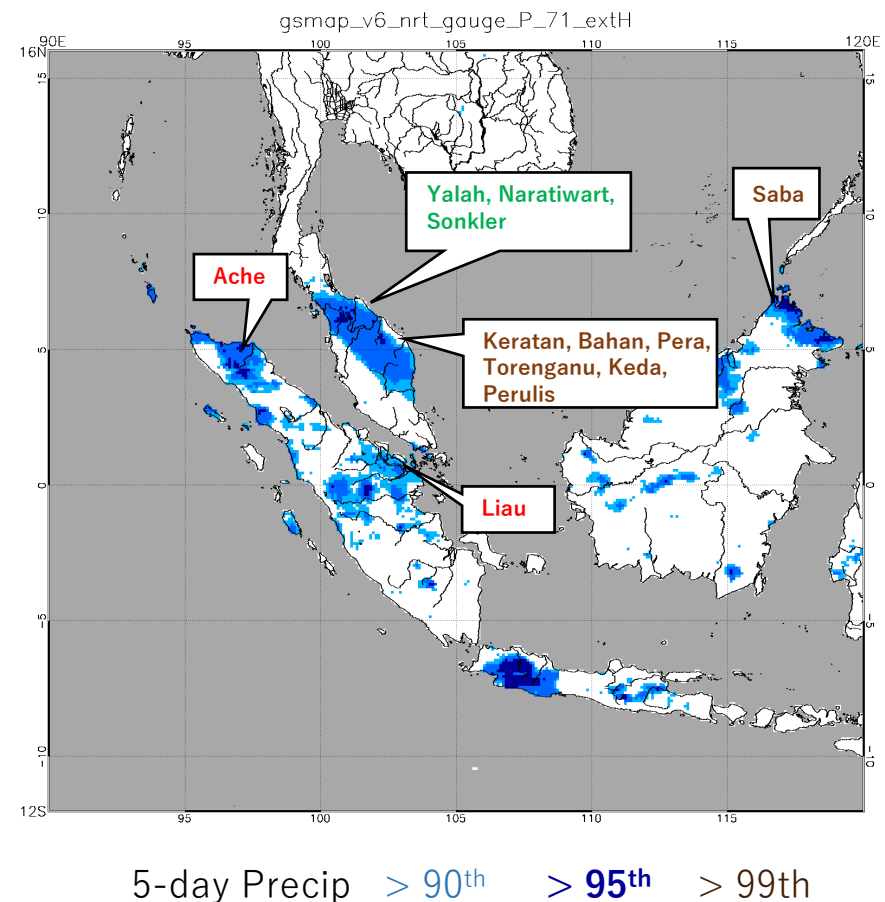
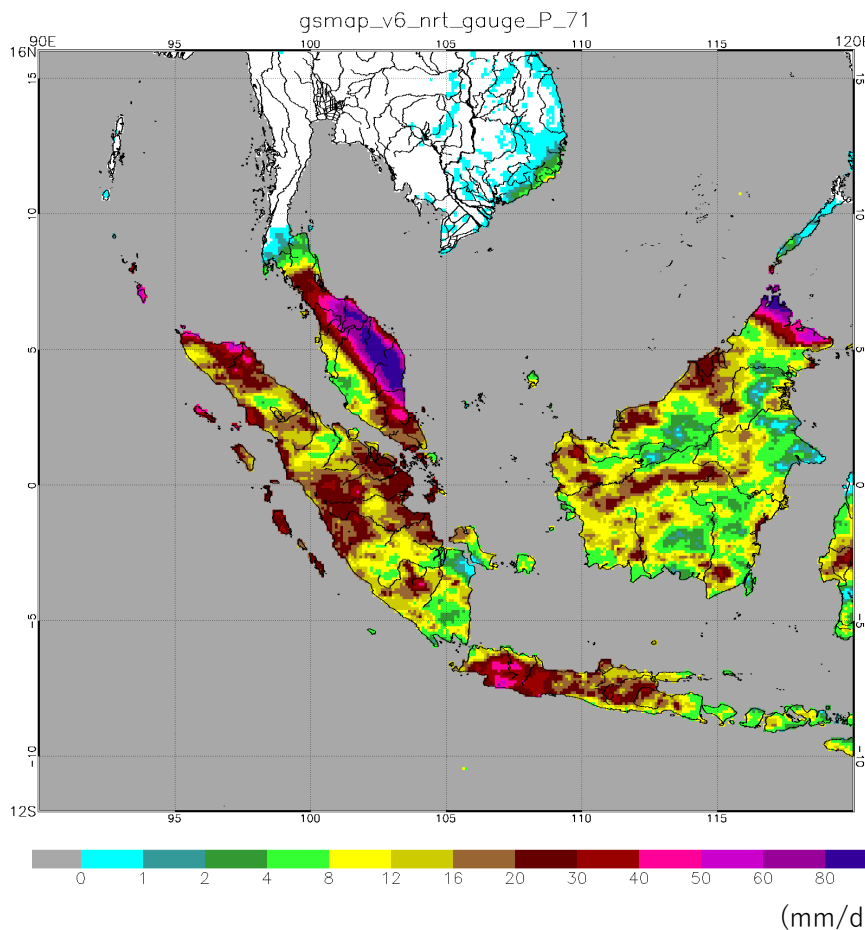


Gauge NRT estimates precipitation much beyond the daily climatology after Dec 14, 2014. Area mean reaches 50mm/day on Dec 23

GSMaP: Detection of 5-day Extreme Precipitation

● December 17-21, 2014

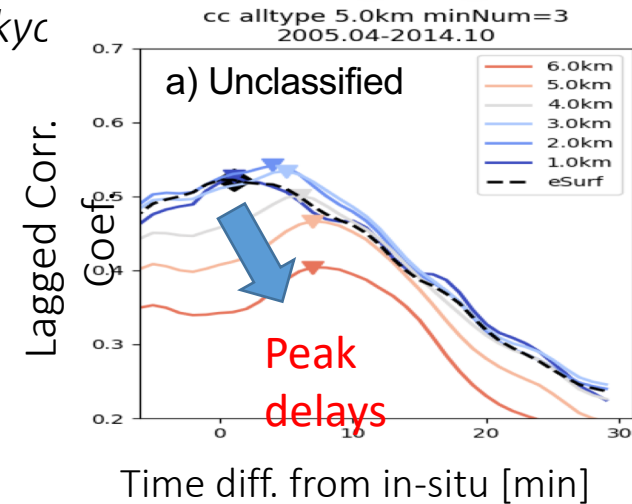
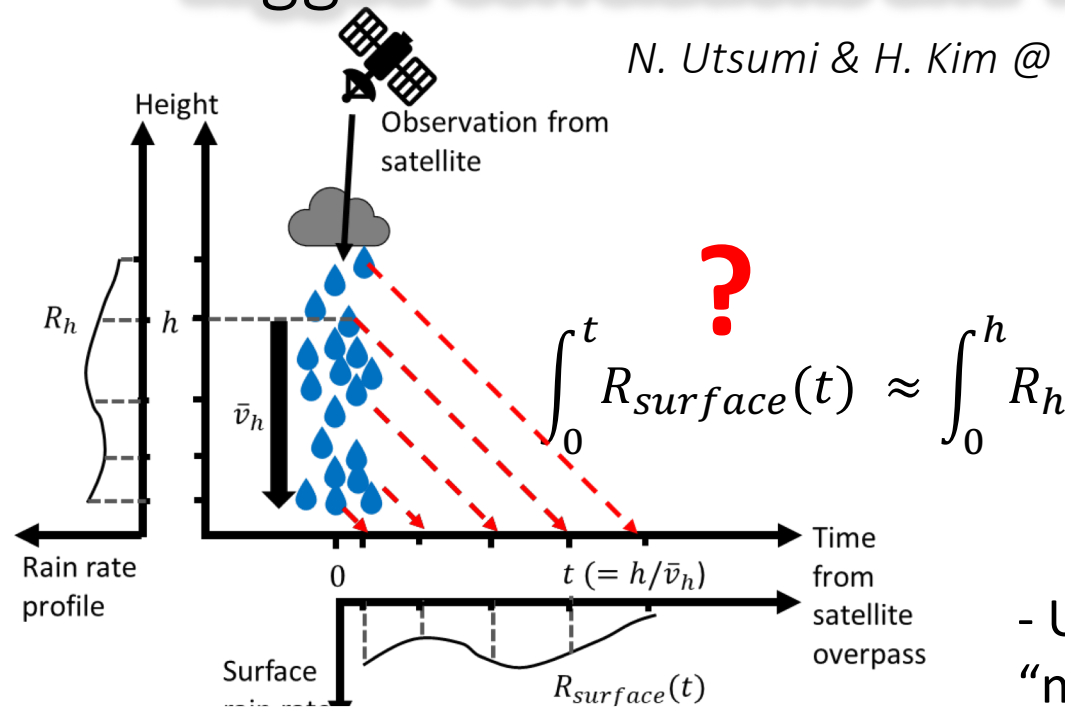
- Dec. 19: Floods in Liao region and Aceh region in Indonesia
- Dec. 21: Torrential Rainfall in Yalah, Naratiwart, Sonkler in Thai, Naratiwart. Floods in Saba in Malaysia
- By Dec 23, most rivers in northern Malaysia reached the flood alert level



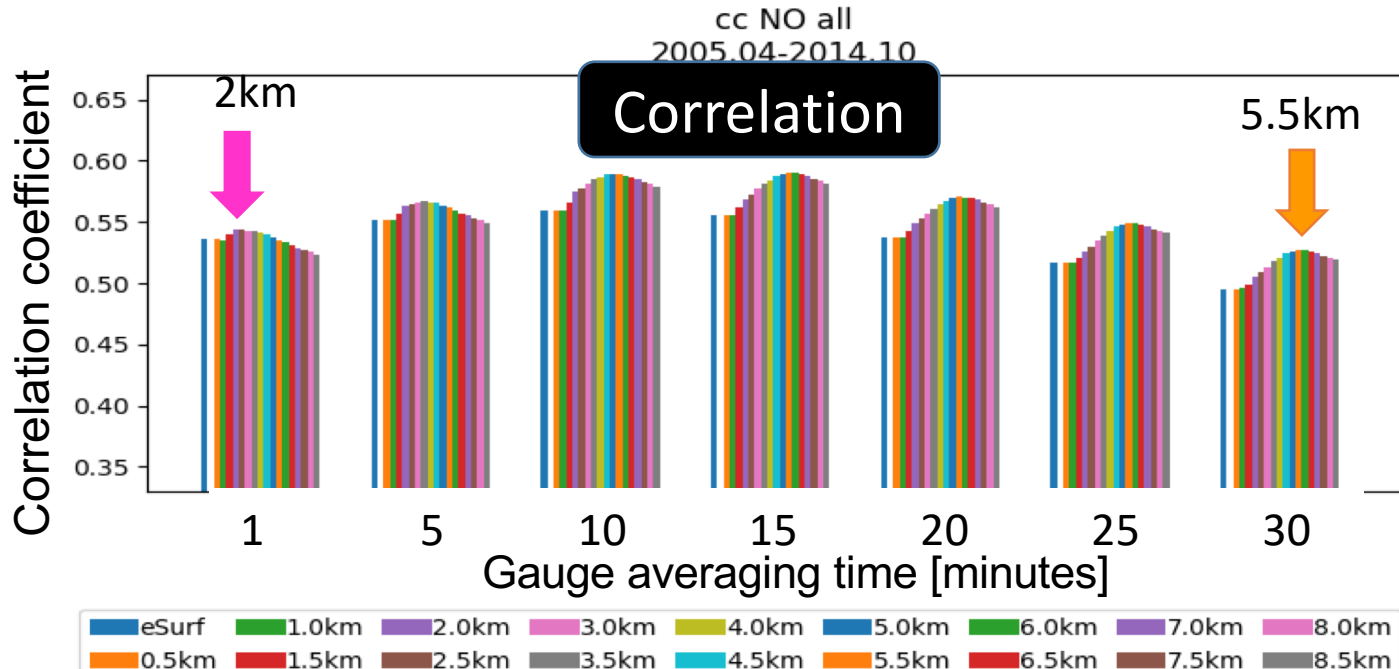
Detected extremes correspond to floods and torrential rainfall reports in various regions.

Lagged Correlations and Vertical Averaging

N. Utsumi & H. Kim @ U-Tokyo



- Upper level prcp. has skills to infer “near future” surface precipitation



With 30-min gauge accumulation,
- 5.5km averaged PR has better correlation than e_Surf Rain.

Averaging height

APPLICATION STUDIES

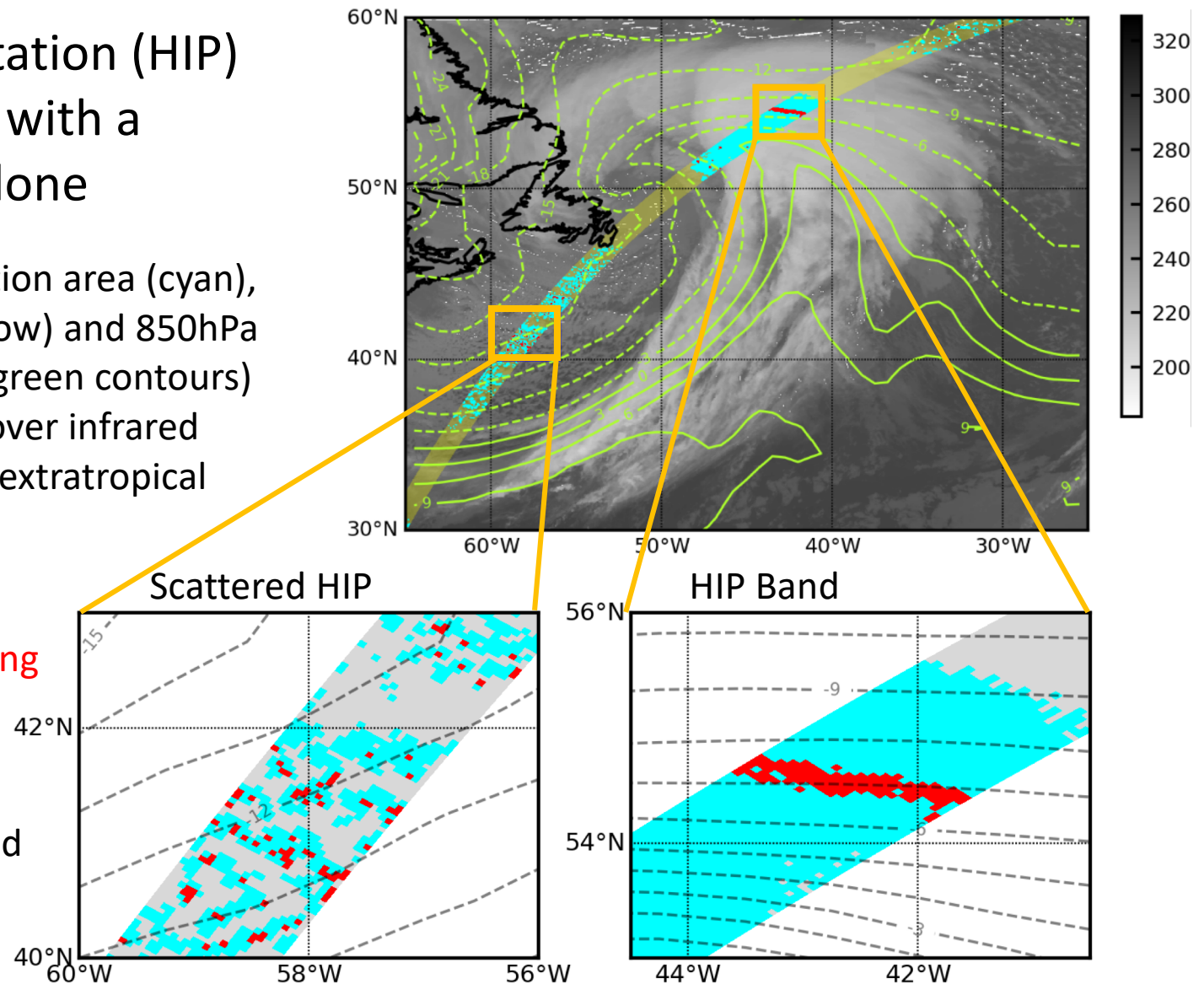
Characteristics of Heavy Ice Precipitation in Extratropical Cyclones Observed by GPM/DPR (**Poster #216**, Wednesday, October 10th)

Akiyama, S., S. Shige, M. K. Yamamoto, T. Iguchi, and M. P. Bauer

Heavy Ice Precipitation (HIP) band associated with a mid-latitude cyclone

HIP (red), precipitation area (cyan),
observed area (yellow) and 850hPa
temperature (light green contours)
are superimposed over infrared
satellite image of a extratropical
cyclone.

- HIP band of tens
kilometers wide **along**
the bent-back front
direction
- Scattered HIP behind
the cold front

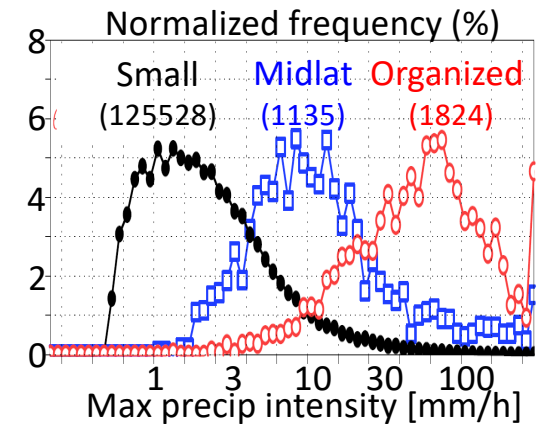
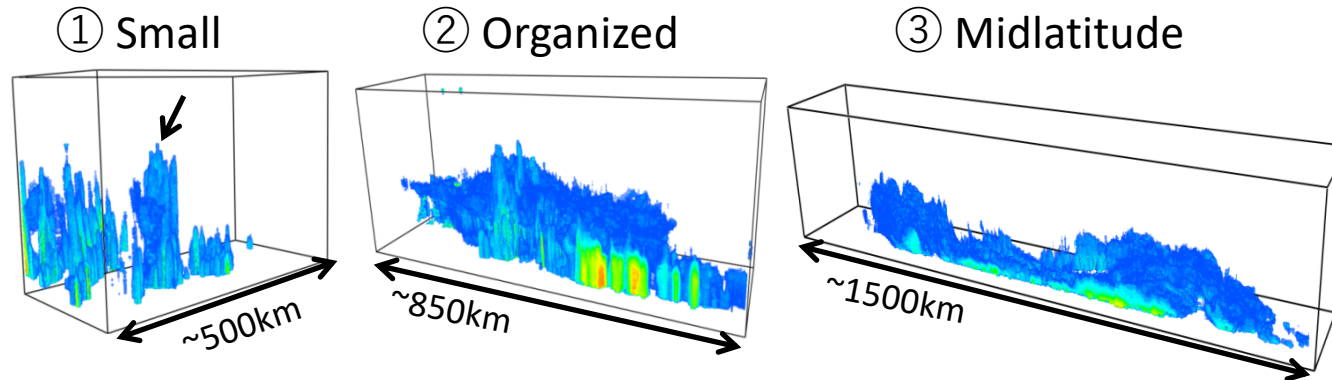


Future projections of early-summer precipitation characteristics around Japan combining GPM DPR observation and CMIP5 model large-scale environments

Chie Yokoyama et al. (2018, submitted)

DPR

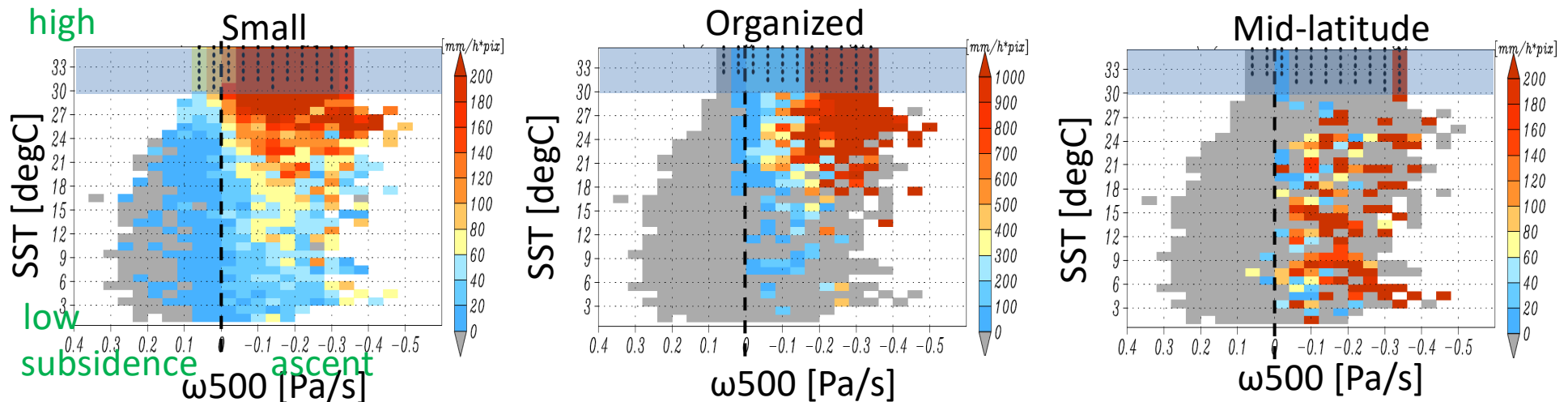
Classified 3 types of rainfall events around the Baiu front



➤ Max. Precip. is significantly more intense in organized systems than other two types.

DPR, JRA55/OISST

Related their precipitation contributions to large-scale environmental conditions

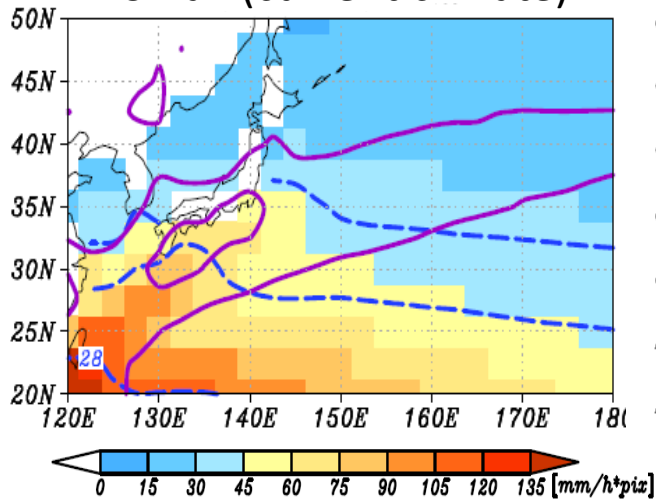


➤ Precipitation-environment relationships for 3 types in terms of SST and ω_{500} .

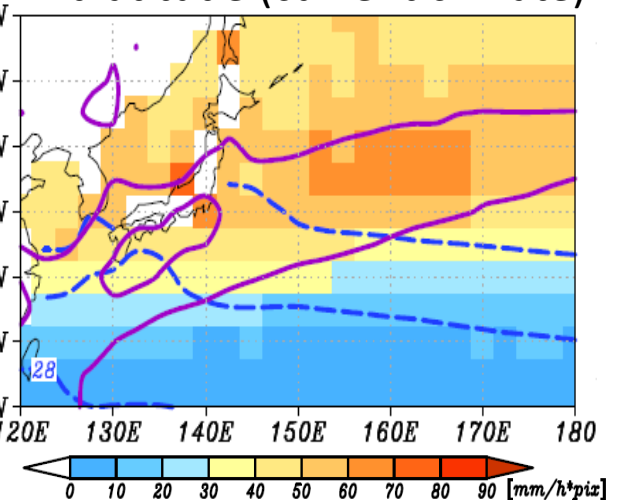
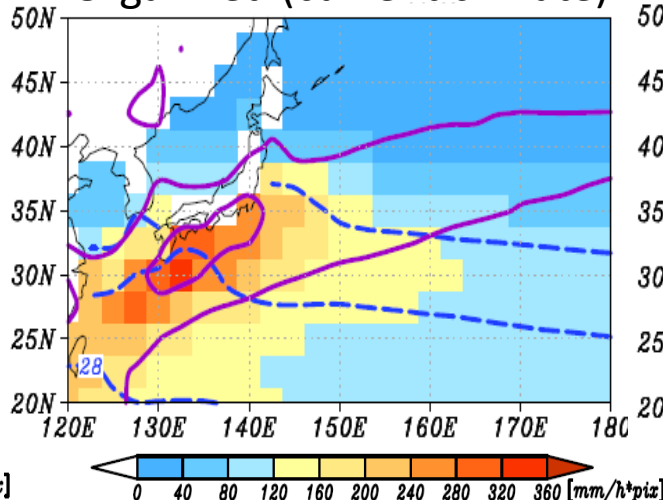
→ Using these tables, precipitation of each type is *reconstructed* with CMIP5 SST & ω_{500} .

Future projections in precipitation *reconstructed* with CMIP5 SST& ω 500, using DPR-based Look-up tables

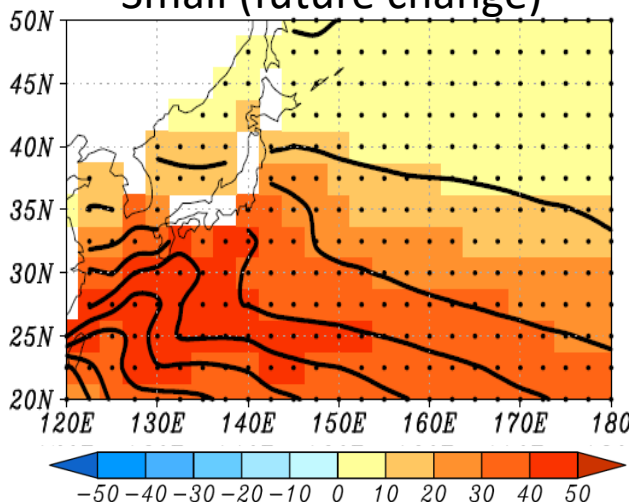
24-model ensemble mean
Small (current climate)



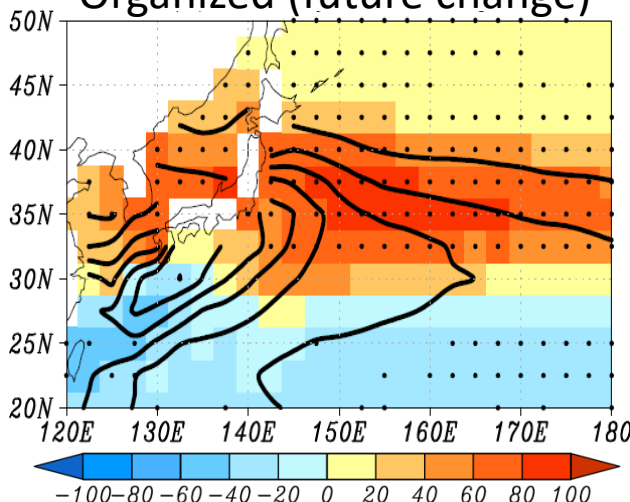
May-July in current (1980-2005) and future (2075-2100) climates
Organized (current climate) Midlatitude (current climate)



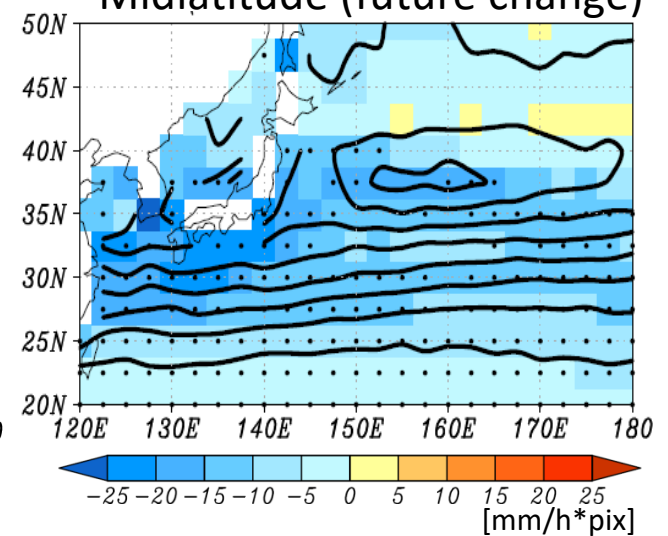
Small (future change)



Organized (future change)



Midlatitude (future change)



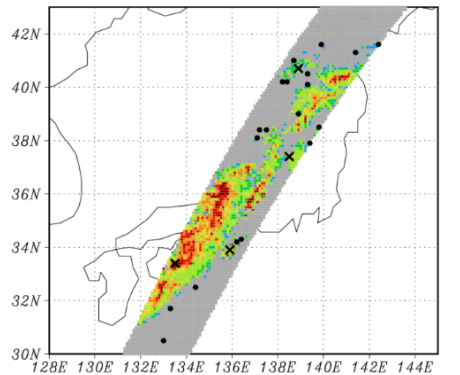
※Dots indicate that sign of changes agrees among more than 90% of the number of models.

- Future changes in precip. largely differ among 3 types.
- A northward expansion of organized type precip.⇒elevated risk of heavier rainfalls in N. Japan

Torrential rainfall event in July 2018, Japan

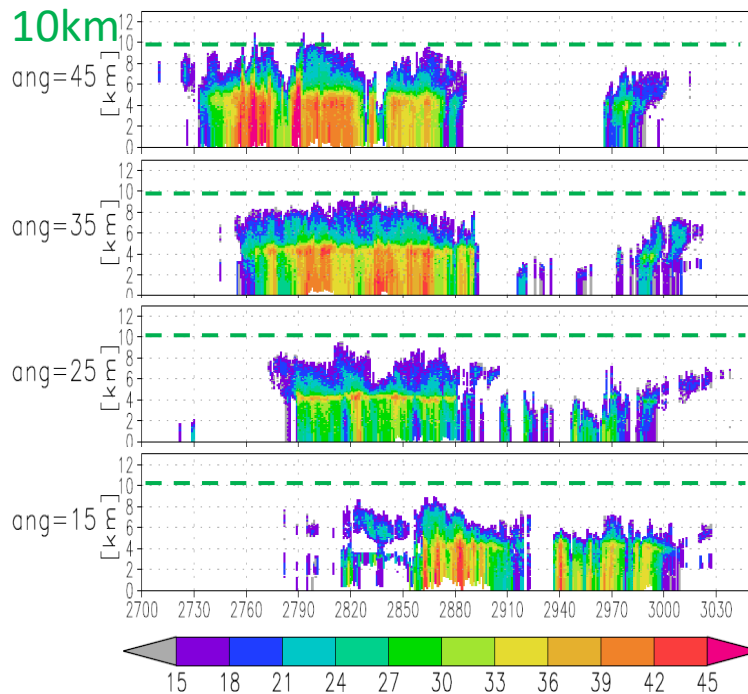
C. Yokoyama et al.

GPM DPR

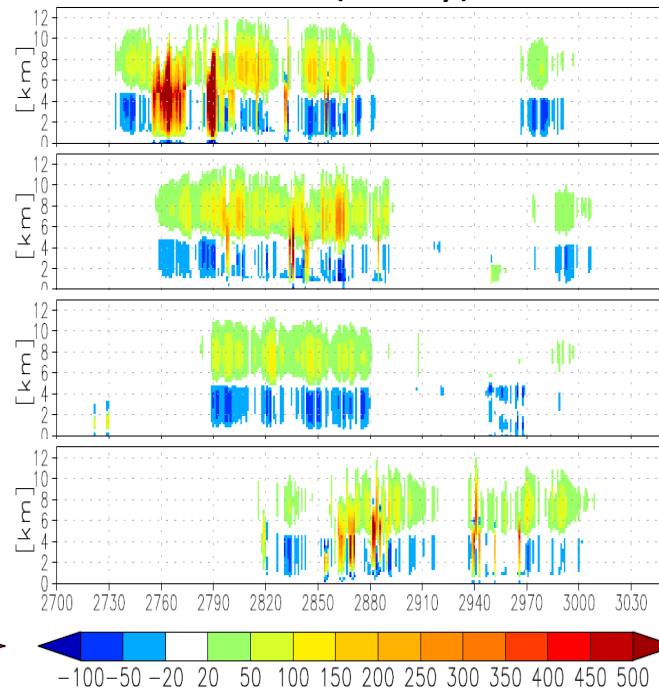


0.5 0.7 1 3 5 7 10 15 30 (mm/h)

Corrected reflectivity (dBZ)

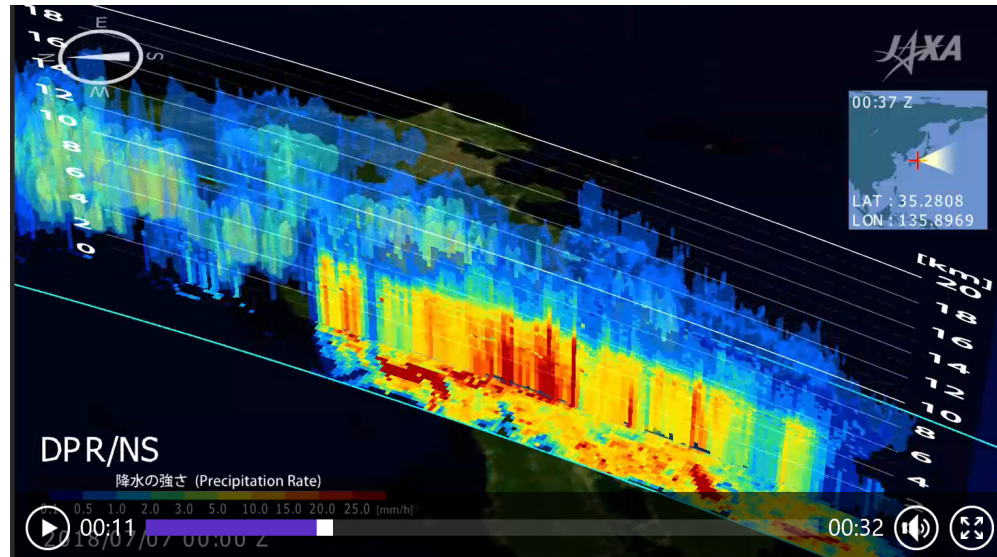
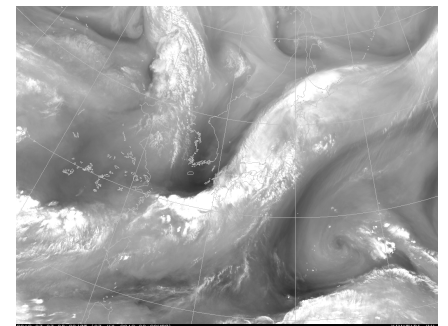


Q1-QR (K/day)



Moderate height
Widespread area
Very intense rainfall
near the surface

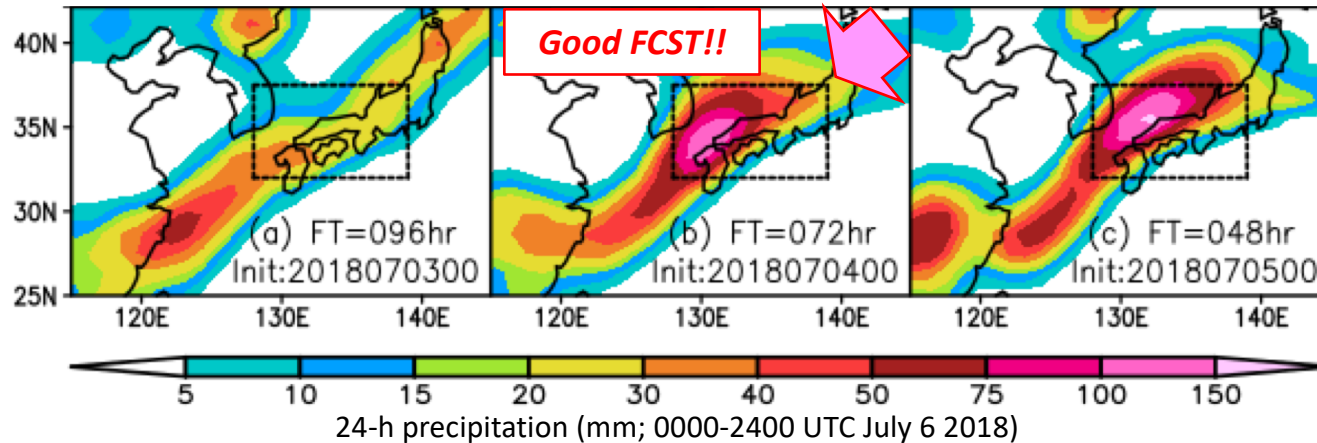
Torrential rainfall was
observed in front of
a stagnated trough



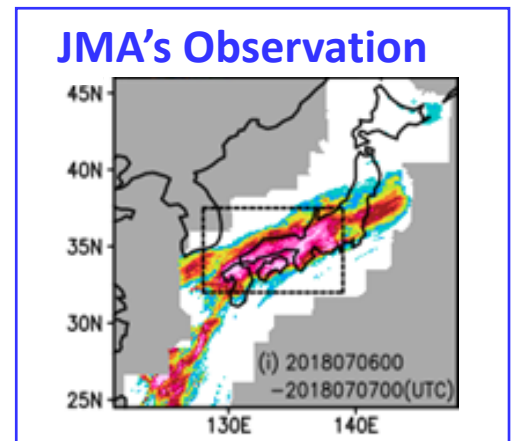
Ensemble Data Assimilation System: NICAM-LETKF

1. NICAM-LETKF JAXA Research Analysis (near-real-time)

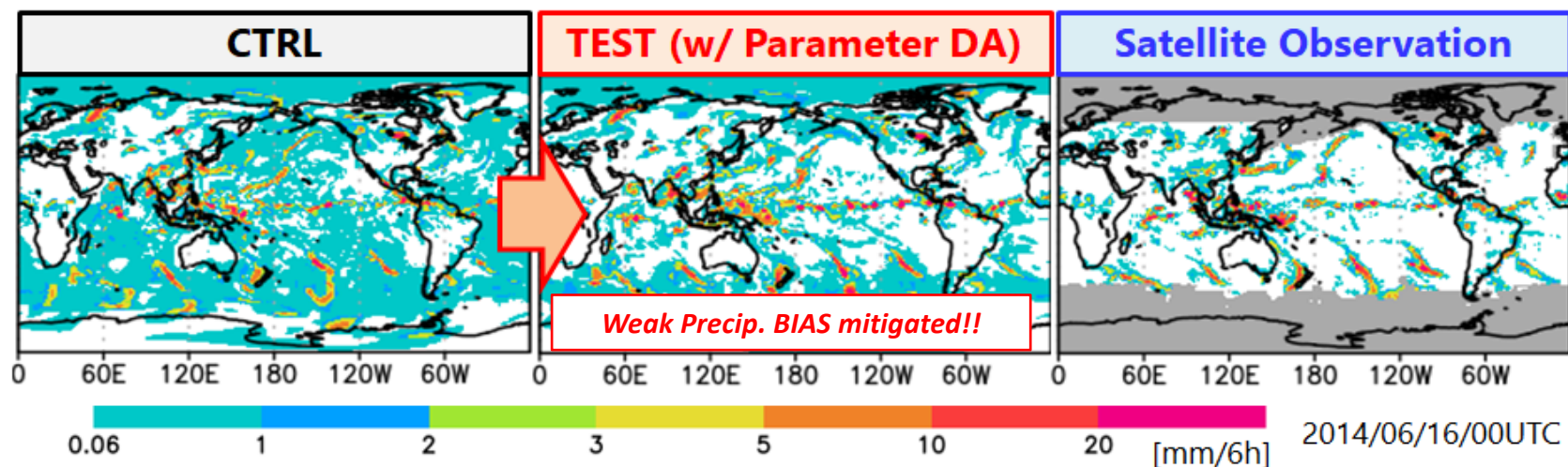
Precip. Forecasts for Record-breaking Event in July 2018



NEXRA



2. Model Parameter Estimation w/ GSMaP



Parameter estimation impact on 6-hr precipitation FCST

Kotsuki et al. (2018, JGR)

Further Utilization of GPM/DPR Dr. Ikuta (JMA)

Characteristics of DPR observation

3-D information of hydrometeors

Sensitivity to snow particles

can not be utilized in
the current system

Enhancement of space-borne radar simulator as observation operator

- **Space-borne radar simulator**

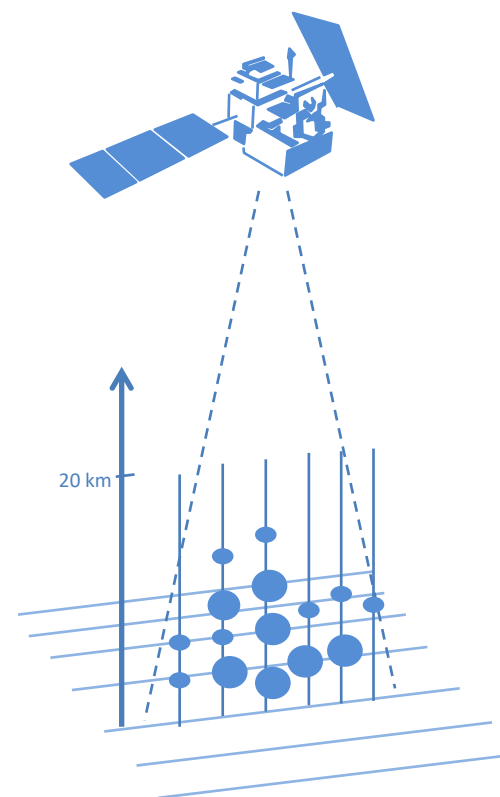
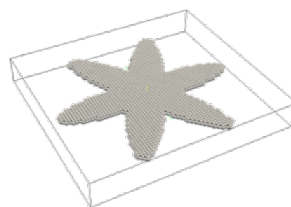
- Simplified to reduce computation cost
 - Beam: Not-bending
 - Ignoring the slant beam path and beam width
 - Effective particle: Rain, snow and graupel
 - Ignoring cloud water and cloud ice particles
 - Size distribution
 - rain and graupel: Exponential distribution
 - snow: Exponential + modified gamma distribution
 - Particle type

- **Non-spherical particle**

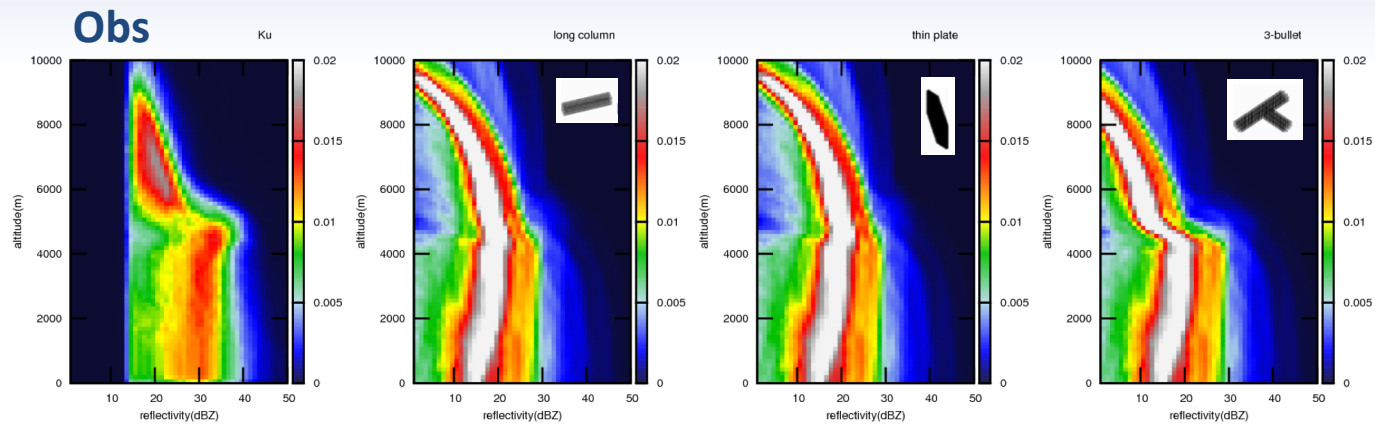
- Scattering calculation

- **LUT (Lorenz-Mie, DDA)**

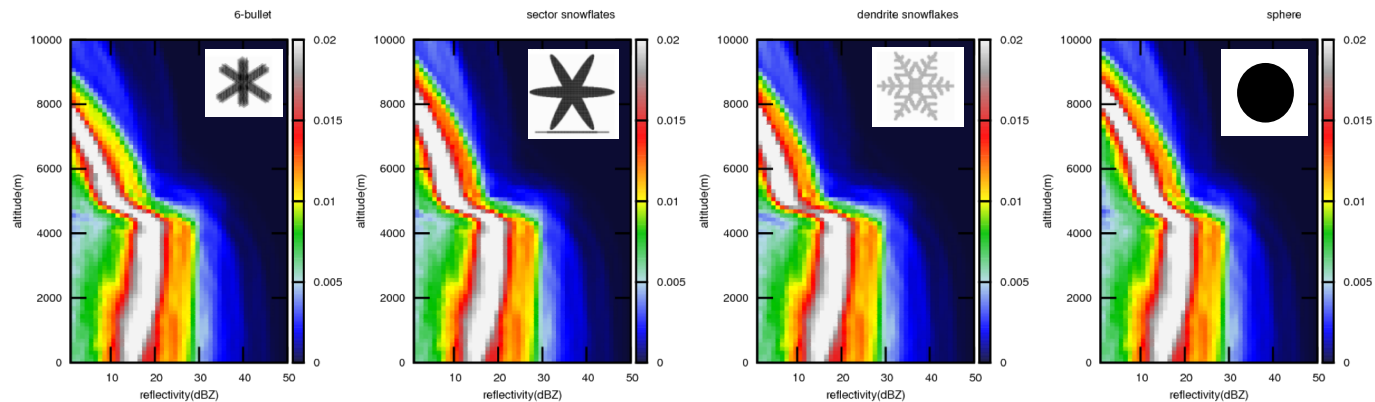
- Single scattering



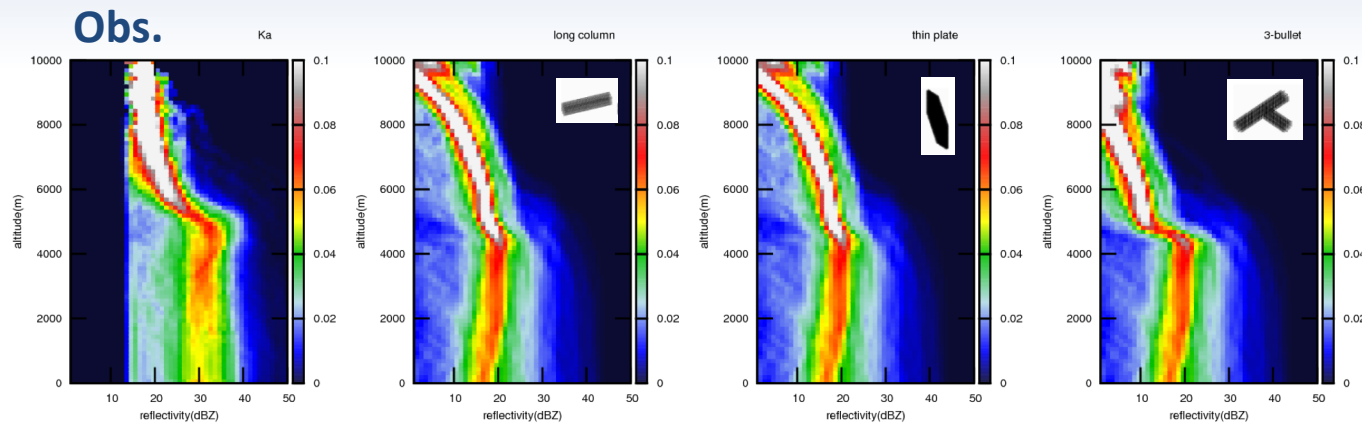
CFADs of KuPR(13.6GHz)



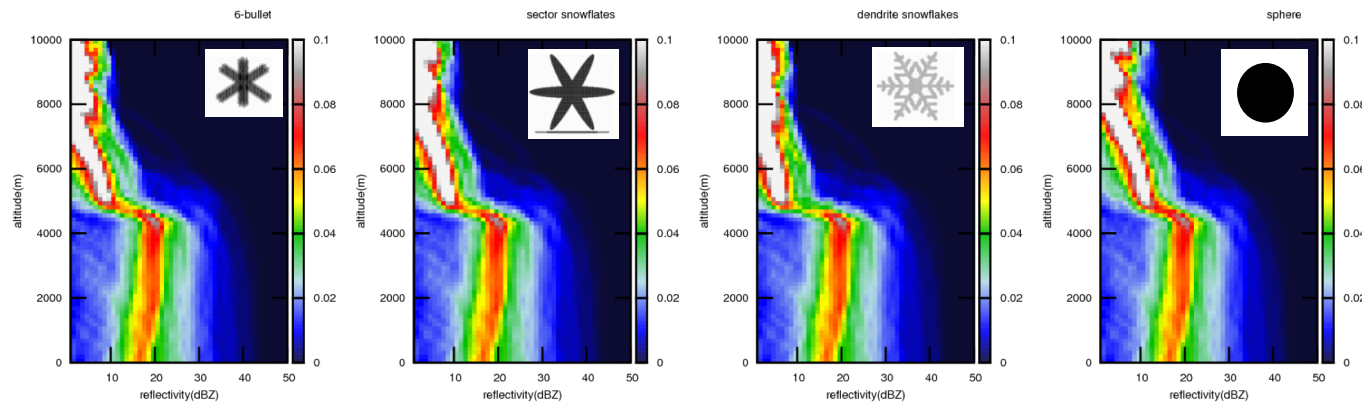
Simulations with Various Particle Types



CFADs of KaPR(35.5GHz)



Simulations with Various Particle Types



At Ku and Ka frequency, no big difference was found with non-spherical solid particles

Future Activities



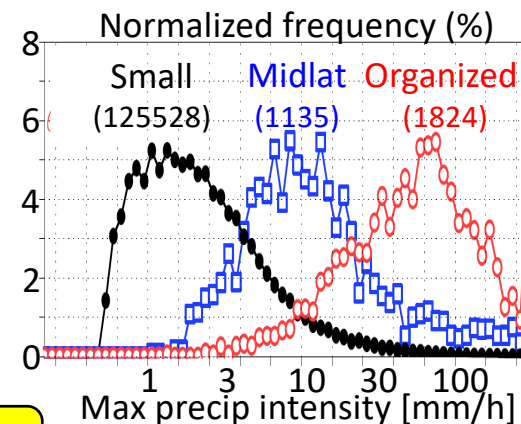
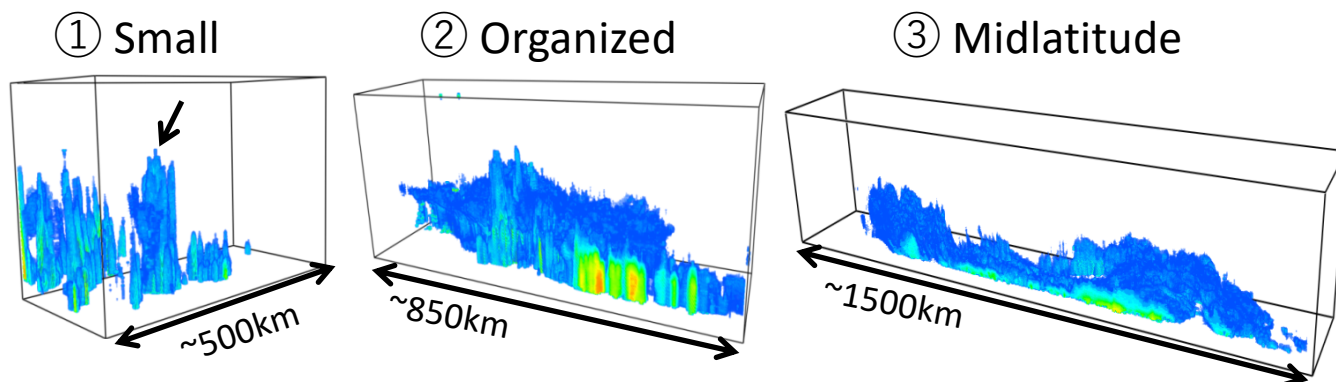
- * New RA will be submitted in Oct. 2018
- * We look forward to our further collaborations



Future projections of early-summer precipitation characteristics around Japan combining GPM DPR observation and CMIP5 model large-scale environments

Yokoyama et al. (2018, submitted)

DPR Identify 3 types of rainfall events



DPR, JRA55/OISST
Relate precip. of each type to environmental parameters (SST, ω_{500})

CMIP5 Future projections of SST & ω_{500}

DPR+CMIP5 Future projections in reconstructed precipitation

Northward expansion of regions affected by organized type
⇒ Elevated risk of heavy rain

